Original Article

Impact of short-term water exercise programs on weight, body composition, metabolic profile and quality of life of obese women

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ABSTRACT

Penaforte, F., Calhau, R., Mota, G.R., & Chiarello, P.G. (2015). Impact of short-term water exercise programs on weight, body composition, metabolic profile and quality of life of obese women.. *J. Hum. Sport Exerc., 10*(4), pp.915-926. Physical exercises performed in water, such as water aerobics, have a minimal impact on the joints and are frequently indicated to help obese individuals to lose weight. The objective of this study was to compare the effects of two water programs (continuous vs intermittent) on the body composition, resting energy expenditure (REE), metabolic profile, and quality of life of obese women without nutritional intervention. Twenty-seven sedentary female volunteers (mean age and BMI of 42.8±7.4 years and 36.1±6.3kg.m-2, respectively) were selected and allocated randomly into two groups: continuous water exercise (CON) and intermittent water exercise (INT). Both programs lasted two months with 3 weekly sessions of 60 minutes each. The following evaluations were performed before and after the intervention: anthropometry (weight and body circumferences), body composition (fat mass and fat-free mass), metabolic profile (glycemia and lipid profile), REE (indirect calorimetry), and quality of life (SF-36 Questionnaire).Comparisons between groups and times (initial and final) were performed using the nonparametric Wilcoxon test. The groups did not differ in any of the variables analyzed at the initial time (Ti) and at the final time (Tf). Comparison of Ti vs f revealed significant reductions of weight (-0.6 kg), BMI(-0.3 kg.m-2), fat mass (-0.6 kg), arm circumference (-1.8cm) and hip circumference (-4.0cm) for CON group and significant reductions of only fat mass (-0.6kg)and arm circumference (-2.0cm) for INT group. Regarding quality of life, improvement in social and vitality aspects was observed in CON group and improvement in vitality and health status in INT group. Short-term water exercise programs not associated with nutritional monitoring have a modest impact on the weight, body composition and metabolic profile of obese women, with better results for programs with continuous characteristics. However, the improvement of quality of life aspects should not be overlooked. **Key words**: WATER GYM, OBESITY, QUALITY OF LIFE, WEIGHT LOSS.

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INTRODUCTION

Physical exercises performed in water such as water aerobics have been extensively recommended because of the various health benefits they provide for those who practice them (Eckerson & Anderson, 1992; Pinto, Alberton, Figueiredo, Tiggemann & Kruel, 2008). This modality of physical activity is highly practiced by both adults and elderly people because, in addition to promoting improvement of physical fitness (Alves, Mota, Costa & Alves, 2004; Kruel et al., 2005; Pöyhönen et al., 2002; Takeshima et al., 2002), of body composition and of cardiorespiratory conditioning (Takeshima et al., 2002), it favors adhesion to exercise programs due to the fact that body weight is not a limiting factor for their practice (Pinto, Dias, Salvador, Júnior & Lima, 2008).

Exercises performed in water have a lower impact on the joints than exercises performed on land since the body "loses" 90% of its weight when immersed in water up to the shoulder level. For this reason, this exercise modality is particularly advantageous for obese individuals,who are at increased risk to develop orthopedic injuries secondary to physical activity, and an exercise intensity kept at a lower level than recommended, in order to achieve improved cardiorespiratory resistance, may be require (Sova, 1998).

Because of the reduced force of gravity in water, the body moves more freely and the total weight is reduced. In addition, the pressure of the water relieves the swelling and pain in the joints and increases body flexibility and mobility, an essential fact for obese individuals considering that excess weight may generate discomfort during exercises on the ground (Kruel et al., 2005; Sova, 1998).

The American College of Sports Medicine (ACSM) recommends that an increased energy expenditure by means of exercise and a reduction of energy intake should be associated in a weight loss program. Physical exercise, in addition to increasing energy expenditure, slows down the rate of loss of fat-free tissue commonly occurring in situations of marked weight loss and also helps maintain the resting metabolic rate. Evidence has indicated that physical training can chronically increase energy expenditure, contributing to weight loss (Poehlman et al., 2002).

Exercise programs with aerobic features are known to promote weight and body fat reduction without significantly altering lean mass, whereas exercises with anaerobic features increase lean body mass and reduce fat mass, but not exert significant impact on overall weight loss (ACSM, 2002; Broeder, Burrhus, Sranevik & Wilmore, 1992). Therefore, the characteristics of the prescribed exercises are very important, since they seem to have a direct impact on body composition of its practitioners. Interval training, for example, seem promote more body fat loss when compared with continuous exercise, and this appears to be associated with increased oxygen consumption after exercise (EPOC) and lipid oxidation, resulting from high-intensity exercise, as the exercise at intervals (Shiraev, & Barclay, 2012; Wallman, Plant, Rakimov & Maiorana, 2009). However, the effects of aerobic versus anaerobic exercise in body compartments of fat and muscle are still controversial (Viana, Filho, Dantas & Perez, 2007).

Few studies in the literature have assessed the impact of water aerobics programs on the weight loss and health of adult obese women. In addition, existing studies vary widely in duration, age of the participants, and objectives and protocol of the exercises applied, with consequent difficulties for comparison of the results. Thus, the objective of the present study was to assess the impact of two different programs of water aerobics (continuous and at intervals) on the body composition, resting energy expenditure (REE), metabolic profile, and quality of life of obese women.

MATERIAL AND METHODS

Participants

The participants were selected among the employees of the University Hospital, Faculty of Medicine of Ribeirão Preto (HCFMRP). Thirty-six female volunteers were recruited based on the following inclusion criteria: body mass index of more than 30kg.m^{-2} and age between 20 and 59 years. We excluded patients with a diagnosis of type I and II diabetes mellitus, arterial hypertension, heart disease, smokers, patients with infectious-contagious diseases, subjects with orthopedic limitations, with medical contraindication of water aerobics, and subjects who missed three consecutive sessions or more than 1/3 of the total sessions.

The study was approved by the Research Ethics Committee of HCFMRP and all subjects gave written informed consent to participate.

Study design

In this prospective experimental study, the participants were assigned at random to two exercise programs: continuous water exercises (CON) and intermittent water exercise (INT). Both programs lasted 8 weeks and consisted of three weekly sessions for a total of 24 sessions of 60 minutes each. The participants were evaluated at the beginning (initial time, Ti) and at the end (final time, Tf) of the study. All evaluations were performed in the morning after a 12 hour overnight fast.

Before the beginning of the study, the individuals of both groups were trained (3 sessions) for adaptation to water. The measurement of heart rate (HR) was made by a frequency counter. All subjects were instructed to keep their nutrition habits throughout the study period. Besides, they were asked to complete dietary records for all 3 days prior the starting the study and the same procedure was performed just after the intervention to report the unaltered nutrition habits throughout the study course.

Water exercise programs

The figure 1 shows the general aspects of the two water exercises programs (CON vs INT). The exercise program for CON group was performed without intervals with continuous movements of the upper (UL) and lower (LL) limbs. The sessions consisted of three phases: 5 initial minutes of warming up/ stretching, 50 minutes of exercises with plastic dumb bells and foam spaghetti involving the large muscle groups of LL and UL, and 5 final minutes of relaxation (cool down).The exercises were performed at 70-85% of maximum HR (HRmax), characterizing moderate to vigorous intensity according ACSM (2011). HR was monitored by being measured at three times during and after the session and was calculated by the formula HRmax = 220 – age (years)[15].

The INT group performed a circuit program consisting of six exercises at 90-95%HRmax, characterizing a vigorous intensity according ACSM (2011). The sessions also consisted of three phases: 5 initial minutes of warming up/stretching, 48 minutes of exercises in series (6 standardized exercises lasting 40 seconds each with intervals of 2 minutes between them and repeated 3 times), and 5 final minutes of relaxation (cool down). HR was measured immediately after each exercise and its value was converted to percent HRmax. During the intervals rest the subjects performed light walk to the next exercise (station) and while waited they walked forward and backward inside the pool to allow active recovery (see figure 1 for better comprehension).

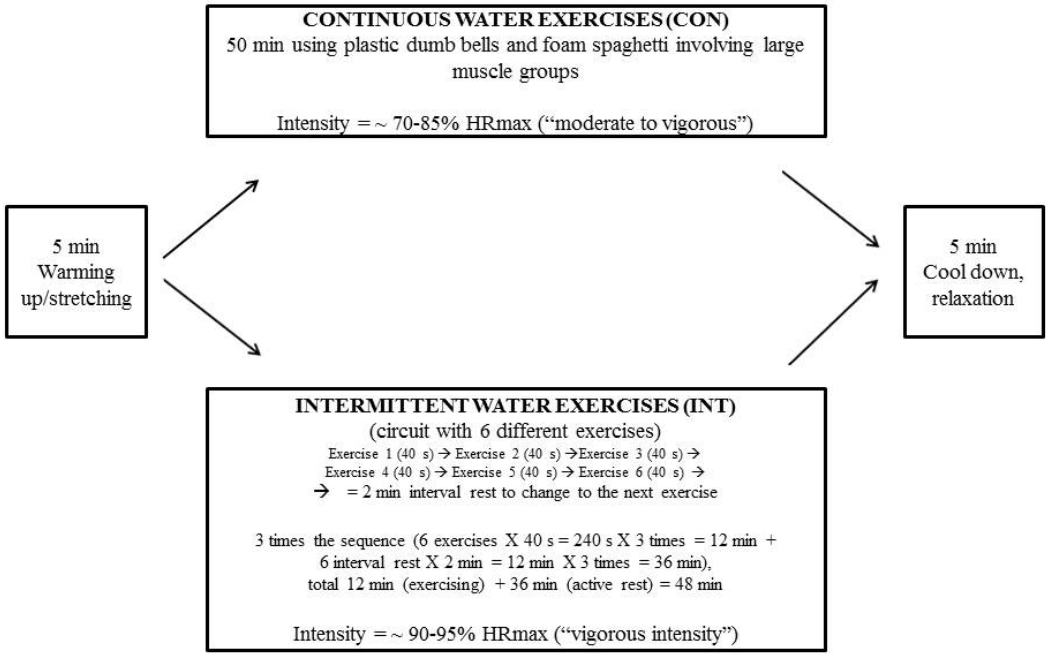

Figure 1. Both groups performed the same warming up (before) and cool down (after the session) phases.

The continuous water exercises (CON) consisted of 50 min performed with continuous movements with plastic dumb bells and foam spaghetti involving the large muscle groups (70-85% of maximum HRmax) and the intermittent water exercises (INT) involved 6 exercises performed in circuit (40 s each one with 2 min interval rest to change to the next exercise, 3 times the sequence, intensity = ~ 90-95% HRmax. The total time for INT, excluding warming up and cool down phases, was 48 min.

All activities were carried out in an indoor pool located in the Center of Physical Education, Sports and Recreation (CEFER) of the University of São Paulo (USP), Ribeirão Preto campus. The water temperature was ~ 30°Celsius (86° F) and the depth of the pool was 1.30m. Additionally, music were used for both groups equally in sequence and pace (session per session) to avoid any potential influence on the motivation from music and, consequently, to the pace of the exercises (Atan, 2013). People were coached to go at own pace to individualize intensity and the progression of the program was done with HR control (i.e. once HR decreased, the pace was increased in regular and individual bases).

Body measurements and resting energy expenditure

Body weight, circumferences (arm, chest, waist, hip and calf), and body composition (fat mass and fat-free mass) were measured and indirect calorimetry (REE) was performed at Ti and Tf.

Body weight (kg) was measured with the subjects wearing light clothing and no shoes using a digital electronic Filizola® scale of the platform type with a maximum capacity of 300kgand precision of 0.1 kg. Height was measured with a stadiometer with 0.5 cm graduations and a maximum capacity of 2.0m. Both measurements were made according to previously standardized techniques (Brasil, 2004). BMI was calculated by dividing weight (kg) by height(m) squared and the subjects were classified according to the cut-off points recommended by the WHO(1998).

The body circumferences were measured with an inextensible tape with 0.1 mm graduations according to standard techniques. The arm circumference (AC) was measured in the midpoint between the olecranon process of the ulna and the acromial process of the scapula. The trunk circumference (TC) was measured by passing the tape below the axillary lines on the horizontal plane at the end of a normal expiration. Waist circumference (WC) was measured at the midpoint between the last rib and the iliac crest and hip circumference (HC) was measured on a horizontal plane at the point of greatest gluteal volume. Thigh circumference (ThC) was measured with the legs slightly apart, with the tape placed immediately below the gluteal fold, and the calf circumference was measured by placing the tape horizontally on the point of greatest perimeter in this region (Callway et al., 1988).

Body composition was evaluated by tetrapolar bioelectrical impedance (BIA), which provides data regarding body water, fat-free mass (FFM) and fat mass (FM). BIA analysis was performed with a model 310A Biodynamics apparatus which uses an 800 μA current and a 50 kHz frequency, according to standardized techniques. FFM and FM were calculated by a predictive mathematical equation specific for obese women (Segal et al., 1998): FFM(kg) = 0.00091186 x (height)2 – 0.01466 x (resistance) + 0.29990 x (weight) – 0.07012 x (age) + 9.37938 ; FM(kg) = W – FFM.

REE was determined by indirect calorimetry (IC) using a Sensor Medics Calorimeter Vmax 29® instrument (Sensor Medics Corporation, Yorba Linda – CA, USA). REE, in kcal.day[1], was calculated by inserting the values of consumed oxygen (V_{O2}) and produced carbondioxide (V_{CO2}), measured by IC, into the formula of Weir (1949).

Biochemical evaluation

Complete serum lipid profile was determined for the evaluation of the metabolic profile: total cholesterol, LDL-c, HDL-c and triglycerides (TG) and fasting glycemia according standardized techniques of the laboratories of HCFMRP. The inter- and intra-assay coefficients of variation of the tests were< 10%.

Fasting glycemia was determined by the oxidase method using the Wiener® liquid AA enzymatic glycemia kit (Wiener laboratories®, Rosario, Argentina).Total cholesterol, HDL-c and TG were analyzed by the enzymatic method using the Wiener® AA liquid line enzymatic cholestat kit. LDL-c was calculated using the Friedewald formula: LDL-c =total cholesterol – (HDL-c + TG/5). This formula can only be applied in cases of TG determinations< 400mg/dl (Friedewald, Levy & Fredrickson, 1972).

Evaluation of quality of life

Quality of life was evaluated using the SF-36 Quality of Life questionnaire, version translated into Portuguese, which consists of 36 items that evaluate functional capacity, physical aspects, pain, general health status, vitality, social aspects, emotional aspects, and mental health (Ciconelli, Ferraz & Santos, 1998).

This questionnaire was chosen because it is generic, self-applicable and validated, being useful for individual patient evaluation and sensitive for the detection of improved quality of life (Castro, Caiuby, Draibe & Canziani, 2003).

Statistical analysis

Data are reported as means and standard deviations. The Wilcoxon test was used for group and time point (initial and final) comparisons. The level of significance was set at $p<0.05$.

RESULTS

Anthropometric, biochemical and body composition variables

Thirty-six participants were selected at the beginning of the study, 17 in CON group A and 19 in INT group. Nine subjects dropped out during the water aerobics program (1 in CON group A and 8 in INT group), with 27 individuals completing the study (CON group A:16 and INT group B:11). There was no major difficulty in implementing the program B, justifying the higher dropout. The reasons of drop out were not recorded, but it is possible that the closeness of the year-end holidays, which affected specially this group, could be the major cause. Furthermore, it also can be thought that it could have been due to the higher intensity of this program of exercise.

At baseline (Ti) there was no difference between groups in the anthropometric, body composition, biochemical, or REE parameters studied (Table 1).

Table 1. Evolution of the anthropometric and REE parameters of groups continuous vs intermittent water programs throughout the study

Variables	CON group (n =16)			INT group (n =11)		
	Ti	Tf	Mean variation	Ti	Tf	Mean variation
Weight (kg)	90.7 (17.4)	90.1 (17.9)	-0.6*	92.6 (19.3)	92.5 (19.2)	-0.1
BMI (kg.m^{-2})	36.9 (5.8)	36.6 (6.1)	-0.3*	35.3 (6.6)	35.3 (6.7)	0.0
FM (kg)	42.4 (11.1)	41.8 (11.0)	-0.6*	42.2 (12.8)	41.6 (41.6)	-0.6*
FFM(kg)	48.2 (6.5)	48.2 (7.0)	0.0	50.4 (7.1)	50.9 (6.9)	+0.5
AC (cm)	40.1 (5.6)	38.3 (4.1)	-1.8*	38.6 (5.6)	36.6 (5.5)	-2.0*
TC (cm)	109.9 (8.4)	110.8 (9.4)	+0.9	112.7 (16.4)	111.6 (13.7)	-1.1
WC (cm)	98.0 (10.2)	97.5 (11.2)	-0.5	98.5 (11.2)	98.0 (15.2)	-0.5
HC (cm)	121.0 (13.8)	117.3 (14.4)	-4.0*	119.7 (13.0)	120.2 (11.5)	+0.5
ThC (cm)	68.5 (8.1)	72.2 (2.5)	+3.7*	68.0 (6.8)	66.5 (4.8)	-1.5
CC (cm)	42.2 (4.6)	42.3 (5.0)	-0.1	41.9 (2.7)	42.0 (2.5)	+0.1
Total cholesterol (mg.dl^{-1})	226.0 (32.8)	227.1 (27.4)	+ 1.1	218.9 (26.5)	217.2 (30.8)	-1,7
Triglycerides (mg.dl^{1})	128.0 (36.4)	140.3 (42.0)	+12.3	140.0 (58.6)	133.4 (50.0)	-6,6
LDL-c	153.5 (30.5)	153.5 (25.3)	0.0	139.2 (24.0)	138.1 (27.2)	-1,1

(mg.dl^{-1})						
HDL-c (mg.dl^{-1})	46.9 (6.9)	45.8 (6.5)	-1,1	51.8 (7.1)	52.2 (10.7)	+0,4
Fasting glycemia (mg.dl^{-1})	81.0 (6.5)	82.5 (5.3)	+1,5	81.2 (18.4)	92.9 (17.6)	+11,7
REE (kcal.day^{-1})	1609.3 (194.7)	1534.0 (179.2)	-75.0*	1604.3 (258.0)	1628.0 (187.9)	+ 23.7

CON= Continuous Water Exercise group. INT= Intermittent Water Exercise group. Ti = initial time, Tf = final time. FM = fat mass, FFM = fat-free mass, AC = arm circumference, TC = trunk circumference, WC = waist circumference, HC = hip circumference, ThC = thigh circumference, CC = calf circumference. REE: resting energy expenditure. Data are reported as mean (SD).* = p< 0.05.

Evaluation of the results within each group in terms of time (Ti and Tf) revealed modest, but significant, reductions of weight, BMI, fat mass, AC and HC, and a significant increase in TC for CON group A. The CON group showed an average weight loss of 0.54 kg, ranging from -2.1 to +3.0 kg. In INT group, the mean weight loss was 0.15 kg, ranging from -3.5 kg to +2.6 kg. Moreover, for the CON group there was also a significant reduction of REE between time points (1609.3 ± 194.7 kcal versus 1534.0 ± 179.2, p<0.05). In INT group there was a significant reduction only in FM and AC. No significant difference were observed in the biochemical variables or the remaining anthropometric variables evaluated. Moreover, comparison of the two groups at Tf revealed no significant differences between groups regarding anthropometric variables, body composition or biochemical and REE variables (Table 1).

Quality of life
At the beginning of the study, the groups were similar regarding all quality of life items evaluated. Comparison of Ti versus Tf revealed improved vitality and social aspects and worsening of pain in CON group, and improved vitality and health status in INT group (Table2).

As observed at Ti, no differences were detected between groups at Tf in any of the items evaluated.

Table 2. Evolution of the Quality of Life variables of CON and INT groups throughout the study.

SF-36	CON group (=16)			INT group (n =11)		
Variables	Ti	Tf	Mean variation	Ti	Tf	Mean variation
Functional capacity	71.5 (18.4)	84.5 (14.7)	+13.0	72.2 (12.5)	78.0 (24.7)	+5.8
Physical aspect	81.2 (35.9)	93.2 (11.6)	+12.0	88.6 (20.5)	90.0 (21.8)	+1.4
Pain	59.6 (20.1)	77.5 (15.0)	+17.9*	74.9 (15.7)	67.7 (29.3)	-7.2

Health status	75.1 (16.2)	80.1 (14.8)	+5.0	69.4 (16.8)	82.2 (17.8)	+12.8*
Vitality	50.9 (17.1)	70.6 (10.7)	+19.7*	55.1 (15.0)	65.8 (14.7)	+10.7*
Social aspects	68.3 (28.1)	85.1 (17.1)	+16.8*	73.7 (26.2)	73.7 (24.2)	0.0
Emotional aspects	64.2 (30.1)	64.8 (27.3)	+0.6	75.2 (12.1)	63.3 (36.0)	-11.9
Mental health	61.3 (21.5)	72.2 (15.7)	+10.9	65.7 (17.2)	71.6 (16.9)	+5.9

CON= Continuous Water Exercise group. INT= Intermittent Water Exercise group. Ti = initial time, Tf = final time. Data are reported as mean (SD).* = p< 0.05.

DISCUSSION

The present result show a certain inefficiency of short-term water aerobics programs carried out continuously or at intervals regarding weight reduction, changes in body composition and lipid profile, or changes in energy expenditure in obese women. The program with continuous exercises showed a slight advantage by providing some improvement in items related to quality of life.

The modest, but significant, weight loss observed only in CON group women suggests that, in this case, continuous water aerobics was more efficient for weight loss than water aerobics at intervals. These findings strengthen the evidence that continuous water exercises are more effective in promoting weight loss, in short term, than intermittent water exercises. However, both interventions achieved similar and significant fat mass loss. More positive results in terms of weight and body composition were obtained by Fett (2005) in a study which evaluated obese women before and eight weeks after continuous vs interval circuit training, although the study involved association with an energy restriction diet. Conversely and Louzada (2007) evaluated changes in body composition in 27 obese women after a program of physical exercises of longer duration than the present one (4 months) which included walks and weight exercises for 30 minutes 2 times a week and also observed no significant variations in body weight.

Even long-term water aerobics programs (8 months), with a mean intensity of 75% of HRM, resulted in significant, although modest, loss of weight (- 2.8kg) and of body adiposity (- 5.3mm), especially considering its duration (Gubiani, Pires-Neto, Petroski & Lopes, 2001). Similar results were observed in review and meta-analysis studies, suggesting that, despite the benefits, the impact of exercise on weight loss is modest, especially when exercise is not associated with nutritional counseling (Garrow & Summerbell, 1995; Wing, 1999).

The benefits of water exercises are related to the physical properties of water, with emphasis on resistance to advancement, which is directly related to the velocity of movement (Pöyhönen et al., 2000). Thus, water aerobics can be used as an alternative form of physical conditioning, taking advantage of the buoyancy of the water as a reducer of impact (Kruel, 2000). It is also important to consider that, even when performing exercises in water, obese individuals have limitations of mobility and difficulty in overcoming water resistance. Thus, the intensity and velocity of the activities may not have been sufficient to generate greater impact on weight and on the remaining variables analyzed, since both are directly related to the results of exercise.

Regarding the modifications of the body circumferences, the results were more positive for CON group, which presented a significant reduction of AC and HC and a significant increase of TC, whereas in INT group, only a significant reduction of AC was observed. Other studies conducted on adult and elderly women also observed greater reduction of body circumferences, such as WC and HC (Lousada, 2007; Monteiro, Riether & Burini, 2004), TC and CC (Gubiani et al., 2001), with predominantly aerobic physical exercises and also of longer duration (32 to 40 weeks), a fact that can explain their better results compared to the present ones. In the present study, since the depth of the pool was 1.30 m, the participants performed the exercises with their legs flexed in order to keep the water at chest level, causing an overload on their legs, a fact that may explain the increase of TC.

Another factor that may have contributed to the small anthropometric and biochemical changes observed in the present study was the duration of the program (8 weeks) and the isolated use of physical exercises for weight loss, not associated with nutritional monitoring. Both factors may have been limiting regarding the efficacy of the water aerobics programs.

The ACSM states that the minimum recommended quantity of exercises in order to obtain health benefits is 30 minutes of physical activity of moderate intensity or 20 minutes of vigorous physical intensity 3 times a week. Regarding weight loss, it has not been fully clarified so far if there are specific types and quantities of exercises more appropriate for this purpose, since there will be individual variations. However, generally speaking, any physical activity increases the probability of success. The International Association for the Study of Obesity (IASO) states that this quantity of exercises is probably insufficient to prevent weight gain for most individuals in today's environment, and recommends the execution of 60-90 minutes of moderate physical activity/day in order to prevent weight gain. IASO also postulates that, even though the use of isolated physical exercise is a valid option for weight loss, a more adequate technique would be its association with diets of low energy content in order to optimize the results (ACSM, 2003).

Regarding the parameters for the assessment of quality of life, there was a significant improvement in vitality and social aspects in CON group and in vitality and health status in INT group. Studies have demonstrated that programs of regular aerobic physical exercise have a positive impact on psychological aspects and on mood disorders such as anxiety and depressions, and also on cognitive aspects (memory and learning), improving quality of life and therefore being considered important therapeutic allies in the treatment of these disorders (Antunes, Stella, Santos, Bueno & Mello, 2005; Cheik et al., 2003; Guszkowska, 2004; Melo, Bolosco, Esteves & Tufik, 2005; Vieira, Porcu, & Rocha, 2007). These improvements are associated with increased endorphin synthesis in the organism of individuals who regularly practice physical activity[38].

We can not ignore the limitations imposed by the small sample size in both groups, which may have hampered the visualization of differences between results produced in each type of intervention. In another sense, the significant differences, even if modest, detected when comparing averages for these variables, show that the characteristics of aerobic or anaerobic water programs can make some difference. Therefore, further research with greater numbers of participants, are needed to confirm these findings.

CONCLUSIONS

The results of the present study demonstrate that short-term water aerobics programs not associated with nutritional monitoring have a modest impact on body weight and composition, with better results being obtained with a program with aerobic characteristics. The improvement of social and health aspects observed with both programs underscores the evidence of the benefits of physical activity for the quality of life of those who practice it.

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